in FIGS. **12** and **13**. FIG. **12** shows the film cooling hole **10** with an inlet metering section **11** having a constant diameter and a diffusion section **12** located immediately downstream in the flow direction of the cooling air. The diffusion section **12** in this particular embodiment includes four separate passages formed by three flow guides. Two outer flow guides **17** form two outer diffusion passages **13** and **14** with the two side walls of the diffusion passage **12**. An inner flow guide **18** forms two inner diffusion passages **15** and **16** with the two outer flow guides **17**.

The inlet section **11** has a constant diameter along the length to provide for metering of the pressurized cooling air through the film hole **10**. The downstream wall is shown in FIG. **13** to have a radius of curvature R**1**, but this curvature is infinite since this surface is flat and parallel to the upper wall surface of the rounded hole.

The diffusion passages **13**-**16** all have expansions in the two sideways directions and the downstream side wall as seen in FIG. **13** which has a radius of curvature R**2** from point A to point B as shown in FIG. **13**. The inner flow guide **18** is shorter than the two outer flow guides **17** so that only three inlets are formed for the four diffusion passages. The two inner diffusion passages **15** and **16** share a common inlet formed by the upstream ends of the two outer flow guides **17**. The three inlets formed by the two outer flow guides have equal flow areas.

The outlets of the outer diffusion passages **13** and **14** have the same flow area. The outlets of the two inner diffusion passages **15** and **16** have the same flow area. The three ribs in FIG. **12** form four flow paths in the diffusion section that have four flow exit areas A**1** through A**4**. The three inlets to the three passages (separated by the ribs **17**) have the same cross sectional area for the same fluid flow entering the passages. The middle passage is further divided by a short rib **18** to form two channels between the longer ribs **17**. The four diffusion passages **13**-**16** can have different outlet areas to regulate the film flow out from the passage. The flow in passage **13** is equal to ⅓rd of the total flow through the inlet section **11**, the flow through passage **14** is equal to ⅓rd the total flow through the inlet section **11**, and the flow in the two passages **15** and **16** combined is also equal to ⅓rd the total flow through the inlet section **11**. Thus, ⅔rd of the total flow through the film cooling hole is discharged out the two side passages **13** and **14** to improve the film layer. In another embodiment, the outlet flow areas A**1** to A**4** could be all equal, or the outlet flow areas A**2** and A**3** can be larger than A**1** and A**4** to produce more flow at the center of the film cooling hole outlet.

FIGS. **14** and **15** show a second embodiment of the film cooling hole in which the film hole is a compound angled film hole. FIG. **12** shows a top view of the film hole with the same basic shape as in the FIG. **12** film hole except the film hole is angled with respect to the hot gas flow path over the film hole. The left side wall has a 0 to 5 degree expansion while the right side wall has a radius of curvature of R**3**. Two outer ribs form three inlets to the diffusion section of the film hole, and two inner ribs of shorter length form three separate diffusion paths inside of the two outer ribs. The total angle of the film hole outlet is from 20 to 30 degrees which is the compound angle of the film hole. FIG. **13** shows a cross section side view of the film hole with the metering inlet section of constant diameter area followed by the diffusion section that has a downstream wall with a radius of curvature of R**2** and an outlet angle of 1.5 to 25 degrees.

In the FIG. **12** embodiment, each individual inner wall of the film cooling hole is constructed with various radiuses of curvatures independent of each other. This unique film cooling hole construction will allow radial diffusion of the stream-wise oriented flow, combining the best aspects of both radial and stream-wise straight holes.

In the stream-wise direction, the straight wall at the upstream side of the film cooling hole has an infinite radius (straight) of curvature while the downstream side wall has a positive radius of curvature, which creates diffusion in the stream-wise flow direction. Also, the straight wall in the upstream flow direction has a built-in tapered flow guide that eliminates the hot gas entrainment problem of the prior art. The end product from the tapered flow guide in the upstream corner yields a diffusion film cooling hole at a much lower cooling injection angle. Thus, shear mixing between the cooling layers versus the hot gas stream is minimized which results in a better film layer at a higher effective level than in the prior art. The curved surfaces on the downstream wall are formed with a continuous arc connecting the point at the end of the metering section and the intersection between the expansion surfaces to the airfoil external wall. The radius of curvature for the lower surface is determined with the continuous arc tangent to the points A and cut through points B. the downstream surface for the film hole has an expansion of between 15 to 25 degrees toward the airfoil trailing edge.

The position of the exit flow guides is dependent on the film flow distribution requirement. It can be positioned at equal inlet area to obtain the same amount of film flow or one can position the flow guide at the large flow area for the corner channel than the middle channels. This allows for a higher film flow in the corner channels for the elimination of vortices formation underneath the film injection location.

In the spanwise direction, the radial outward and radial inward film cooling hole walls can be curved at the same radius of curvature. This increases the film cooling hole breakout and yields a better film coverage in the spanwise direction. This film cooling hole expansion, between 15 to 25 degrees, is valid only if the hole is oriented in the stream-wise direction or at a small compound angle at less than 20 degrees. However, if the cooling hole is used in a highly radial direction oriented application (greater than 40 degrees from the axial flow direction) then the radial outward surface for the film cooling hole has to be at a different radius of curvature than the radial inward surface. The radial outward surface will be at an expansion of less than 7 degrees. For this particular application, the radius of curvature for the inward wall can be much smaller than the outward surface and the expansion angle will from 20 to 30 degrees which is larger than the 15 to 25 degree expansion used for the stream-wise angled film hole. FIG. **12** shows details of the compound angled curved film cooling hole. The end product of this differential yields a stream-wise oriented cooling flow injection flow phenomena for a compound angled film cooling hole with a much larger film coverage.

I claim the following:

1. A film cooling hole for an air cooled turbine airfoil used in a gas turbine engine, the film cooling hole comprising:

An inlet section forming a metering section for the film cooling hole;

A diffusion section located downstream from the metering section;

The diffusion section having a downstream wall and two side walls all with a positive expansion;

The diffusion section including two long ribs forming three inlets of equal cross sectional flow area; and,

The diffusion section including a short rib formed between the two long ribs, the short rib and the two long ribs forming two outlets.